radiation applications need dosimetry

Radiation's beneficial uses are spreading into many fields. Special measuring instruments known as dosimeters ensure effectiveness of its applications and add to safety. Dosimeters can be pieces of film, capsules containing powder, some chemical substances, electronic instruments or even pieces of glass. Some aspects of the science of dosimetry, applications making the use of radiation cheaper, and Agency action to ensure its efficiency in practice are discussed here by Horst Eisenlohr and Walter Moos of the Division of Life Sciences.

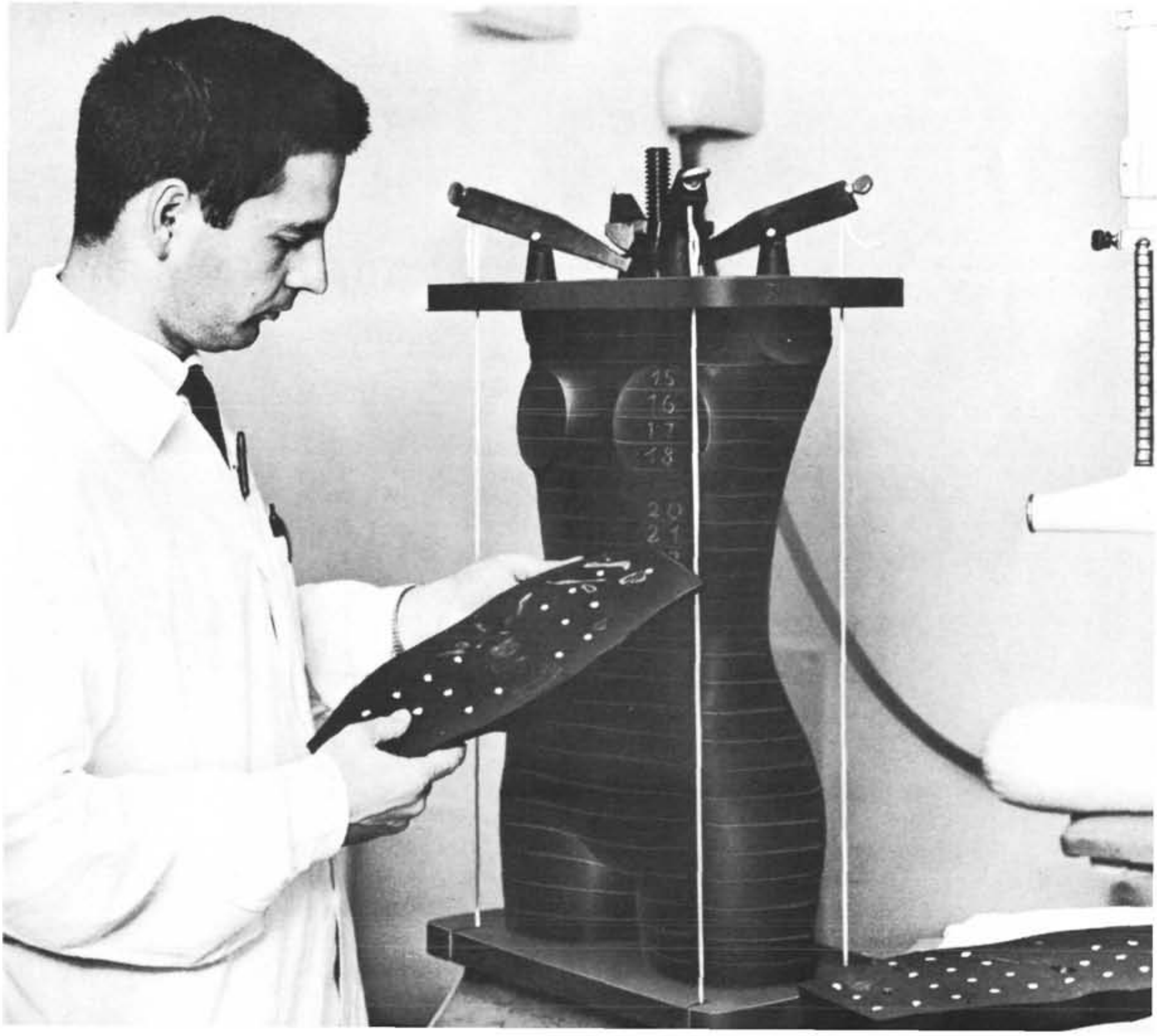
Dosimetry materials used in a human model give accurate information for hospitals using radiation treatment.

Accurate dosimetry, that is the quantitative determination of radiation energy absorbed, is a necessary prerequisite for practically all applications of ionizing radiation.

In recent years the use of radiation has expanded so rapidly into many new areas that medical dosimetry, though still a very important item, is no longer as dominant an interest as other applications. Industry, particularly where biological material is being processed, has turned strongly to irradiation processes, one important example being the sterilization of medical supplies.

Improvements or modifications of dosimetric procedures in agricultural projects have been developed to fit particular economic, educational and environmental circumstances. One co-operative effort between the Dosimetry Section and the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture has led to the development of a simple dosimeter system. This device, essentially a small glass tube containing chemicals, undergoes a colour change when exposed to ionizing radiation.

Such a simple and inexpensive dosimeter is highly advantageous when large numbers of fly pupae are irradiated utilizing the sterile insect release technique because it is essential to ascertain that no unirradiated pupae are inadvertently shipped for release. The sensitivity of the dosimeter solution is sufficient to distinguish between absorbed doses of 1, 10 and 20 kilorad, and the solution is chemically stable for some



time if stored in proper conditions. The cost is about two US cents per ampoule. Its application makes the sterile insect technique for control and eradication of pests safer and cheaper.

Another useful purpose might be served by the development of simpler dosimetric methods than now exist to study the influence of radiation dose contributions to the ecosystem after peaceful nuclear explosions; a system which might facilitate inspection methods under the safeguards programme and assist with many other problems. Naturally these items need very thorough studies, much further work and evaluation before a valid conclusion as to their feasibility can be drawn. The potential possibilities of dosimetry and its applications are limited only by the imagination and resourcefulness of the human mind.

Naturally medical dosimetry cannot be neglected. It still is and will always remain an extremely important task. The Dosimetry Section of the Agency is therefore working very closely with the World Health Organization (WHO), since the success of radiation treatment is decisively dependent on the correct implementation of the treatment plan. While there are thousands of radiotherapy hospitals throughout the world, equipped with the most up-to-date radioisotope sources, many of them do not have the necessary dosimetric equipment, and only a few have the permanent advice of a full-time hospital physicist. Unprecise dosimetry may lead to maltreatment, causing unnecessary loss of life. The situation calls for considerable improvements in both developed and developing countries.

The IAEA has, therefore, organized a radiation dose inter-comparison programme in which hospitals of all Member States may participate. The participant receives by mail a set of capsules filled with lithium fluoride powder, together with a holder and detailed directions. He is requested to put the dosimeters in a water phantom (so-called because it takes the place of a patient in order to simulate actual conditions) and to subject it to irradiation with radioactive cobalt at a specified dose (500 rad). He must then send the capsules back to the IAEA for individual and statistical evaluation. The inter-comparison is based on the participation of one or more National Standards Laboratories, the exposures of which are taken as an absolute reference.

Up to now 160 institutions from 47 countries have participated in this service. The number of institutions applying for participation is continuously increasing, reflecting its need and value.

The results of the dose inter-comparisons, which started in 1966, are very interesting: The mean dose delivered by some 30 arbitrarily selected hospitals lies very close to the true dose value indicating equal probability for under and over exposure. There are, however, individual deviations from the true value which in some cases go as far as 30 to 40%. In such cases the participant is informed immediately and advised to check his equipment. On request he then can obtain another set of dosimeters to test his new calibration. All information is, of course, treated confidentially.